TECHNOLOGY EDUCATION

CREATIVITY AND INNOVATION

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Beyond Paper Solutions

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FOREWORD

"Creativity and Innovation" was written by Michael J. Doyle of Belfast Central School, Belfast, New York, and Barbara Van Wicklin of Cattaraugus-Allegany-Erie-Wyoming B.O.C.E.S, Olean, New York.

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STATEMENT OF PURPOSE:

Creativity is a human resource that society cannot afford to undervalue. History has shown that creative minds contributed in a vital way to the advancement and well-being of mankind.

A critical goal of secondary education must be to nurture creativity in our students. Our society is facing, and will face, complex and ever-changing problems. It is our duty, and within our capacity, as educators to begin to prepare our students to become the creative and innovative, problem solving adults of the future. It is with this purpose in mind that the Technology Education course "Creativity and Innovation" has been designed. The overall goal of "Creativity and Innovation" is to foster and develop within the student the skills, knowledge, behavior and concepts that lead to the application of thoughtful, creative, problem solving behavior in technology.

DESCRIPTION OF THE COURSE:

"Creativity and Innovation" will expose students to problem solving techniques and systems, styles of thinking, methods for generating multiple ideas or solutions, and techniques for development and communication of ideas.

The course plan will consist of four modules, each having a multiple focus, a theory portion related to creative problem solving, and a practice or application portion related to technical problem solving. Students will participate both individually and in learning teams, on selected topics.

INSTRUCTIONAL OVERVIEW:

When applied to real problems, creative problem solving is not always linear, as it provides feedback at many stages and levels. "Creativity and Innovation" will be presented in a sequential order for instructional purposes only. The course will move from well defined to loosely defined problems, to those which are complex and unclarified. The instructor's role will evolve from teacher to leader to facilitator. Students will experience low and moderate risk as they learn to become problem solving risk takers. (See charts in Appendix G.)

INSTRUCTIONAL CONSTANTS:

Daily Log

Students will be required to keep a daily log of visual records (e.g., drawings, sketches), notes and instructional information, and ideas, facts and references related to problem solving and design.

Linkages

Opportunities exist throughout each module to combine the individual elements therein. For example, the theory portion of the module, dealing with creative problem solving can -- and should -- be linked with the application portion dealing with technical problem solving. In addition to those listed, instructional strategies can be developed for use by the instructor for specific technological systems not addressed.

Creativity

Creativity is an idea or process which is new, unique and pleasing to the creator or to someone else at a particular point in time, regardless of whether it has been previously discovered by another or whether it must wait until a later time or different situation to be appreciated.

Creative thinking skills, such as fluency, flexibility, originality and elaboration, are to be stressed in the activities of this curriculum. Performance objectives alone are not sufficient to cover all the outcomes and needs emanating from student impact on the activities conducted. It is expected that instructors and students will foster among each other creativity in delivery of, and response to, this curriculum.

ELEMENTS OF AN ENVIRONMENT CONDUCIVE TO FOSTERING CREATIVITY

The following recommendations identify some ways in which an educator can foster an atmosphere conducive to creativity and innovation. This list provides only some of the conditions necessary for creativity:

1. Provide freedom to try new ways of performing tasks; allow and encourage individuals to achieve success in an area and in a way possible for the individual.

2. Permit the activities, tasks, or curriculum to be different for various individual differences, styles and points of view.

3. Support and reinforce unusual ideas and responses of individuals when engaged in both critical and creative types of thinking; establish an open atmosphere.

4. Encourage individuals to have choices and be a part of goal setting and the decisionmaking process; build a feeling of individual control over what is done and how it might best be done.

5. Let everyone get involved, demonstrating the value of involvement by supporting and helping to develop individual ideas and solutions to problems and projects; encourage the use of the Creative Problem Solving Process where appropriate.

6. Provide an appropriate amount of time for the accomplishment of tasks: the right amount of work in a realistic time frame.

7. Communicate that you are confident in the individuals you work with rather than against them; provide a nonpunitive environment.

8. Recognize some previously unrecognized and unused potential; challenge individuals to solve problems and work on new tasks.

9. Respect an individual's need to work alone; encourage self-initiated projects.

10. Tolerate complexity and disorder, at least for a period; even the best organization and planning using clear goals requires some degree of flexibility.

11. Use mistakes as positives to help individuals realize errors and meet acceptable standards in a supportive atmosphere; provide constructive feedback and use appropriate evaluation procedures.

12. Criticism is killing ... use it carefully and in small doses; use encouragement and reduce concern over failures.

13. Adapt to individual interests and ideas whenever possible.

14. Allow time for individuals to think about and develop their creative ideas; not all creativity and innovation occurs immediately and spontaneously.

15. Create a climate of mutual respect and acceptance among individuals so that they will share, develop and learn cooperatively; encourage a feeling of interpersonal trust.

16. Be aware that creativity is a multifaceted phenomenon -- it exists in a variety of contexts ... not just arts and crafts.

17. Encourage divergent activities by providing resources and room rather than controlling every element of the tasks to be accomplished.

18. Listen to and laugh with individuals; a warm supportive atmosphere provides freedom and security in exploratory and developmental thinking.

19. Encourage and use provocative questions; move away from the sole use of convergent, one answer questions.

20. Encourage a high quality of interpersonal relationships and be aware of factors like a spirit of cooperation, open confrontation of conflicts, and the encouragement of the expression of ideas.

The above is taken from a presentation made by Dr. Scott Isaksen: "Conceptions of Creativity." The list is a synthesis of the work done by Torrance (1962), Torrance and Myers (1970), MacKinnon (1978), Amabile (1984) and VanGundy (1984). Reprinted with permission.

MODULE 1: SENSING PROBLEMS AND CHALLENGES
INNOVATORS/INVENTIONS
INTRODUCTION TO APPLIED VISUAL TECHNIQUES

DESCRIPTION OF MODULE:

In this module, students will explore introductory problem solving skills and develop a sensitivity for conditions in need of change.

In our life experiences, most of what we acknowledge as truth depends on our perception of our awareness of the moment. In the words of Frederick Langbridge: "Two men look out the same bars, one sees mud and one sees stars."

To begin to develop sensitivity for those things that might be improved or changed, we must wake the sleeping, shake up our thinking, heighten our conflict awareness and make new connections in our mind's eye. Opportunities abound for those who can perceive them. How can it be, for instance, that so many of our so-called "convenience" foods are so inconvenient to open and use, and their byproducts so inconvenient or difficult to discard?

To strengthen our awareness of the details of our environment, we must first heighten our perception of it. Since much of what we sense is processed visually, drawing is one of the key factors in heightening our perception of detail. The purpose of drawing in "Creativity and Innovation" is not for art's sake, but to record, communicate and formulate ideas and images. Drawing is a fundamental skill for the solution of technical problems.

The study of the creative efforts of innovators, inventors and inventions helps to develop insight into the nature and characteristics of innovators and inventors. It also imparts an understanding of the impact of their work on mankind.

This module has a multiple focus:

FOCUS 1: SENSING PROBLEMS AND CHALLENGES

Sensing problems, challenges and opportunities is intended to develop a sharpened sensitivity and awareness of things in need of change. Much of the impetus for human progress and technological growth is the realization that things can be improved. When we sense that something needs to be changed, a basic step has been taken towards the identification of the real problem.

Student Actions

- Identify wants, needs and values.
- Use deferred judgment.
- Identify divergent and convergent thinking.
- Project or role play points of view.

- Identify prob ems and challenges in need of solutions.
- Identify oppor unities for development.
- Sketch to desc ibe and record information.

FOCUS 2: INNOVATORS/IN ENTIONS

Innovators/Inventions is designed to extend the student's knowledge of the lives and creative efforts of innovators. They will also research key inventions and discoveries that affected human progress.

Student Actions

- Use library research skills.
- Research and analyze data collected.
- Write a paper using documentation, notetaking and related writing skills.

FOCUS 3: INTRODUCTION TO APPLIED VISUAL TECHNIQUES

Three kinds of visual imagery are necessary for effective visual thinking techniques used to solve problems: perceptual imagery is the sensory experience of the world; mental imagery is constructed in the mind and formed generally from the perceptual imagery; graphic imagery is the drawn or sketched image that allows recording, storage, manipulation, communication and clarification of the idea or concept to yourself or another. Through sketching, drawing and activities related to perceptual, mental and graphic imagery, students will learn APPLIED VISUAL TECHNIQUES for creative problem solving in technology. In addition students will use these techniques to record ideas from "Focus 1" in their daily log.

Student Actions

- Apply the principles of pictorial drawing and sketching.
- Produce sketches for recording, communication and formulation of ideas.
- Apply principles of geometric construction in drawing.
- Use modeling tools and materials for introductory two- and three- dimensional models.

SKILLS, KNOWLEDGE AND BEHAVIORS TO BE DEVELOPED:

The ability to:

1. Identify problems and challenges in need of solution.
2. Utilize library research skills.
3. Participate in activities that require deferred judgment.

4. Identify convergent and divergent styles of thinking.

5. Draw sketches for recording realistic graphic images in pictorial drawing (isometric, oblique and/or perspective).

6. Produce sketches for recording, communication and formulation of ideas.

7. Draw solutions to geometric design problems.

8. Model solutions to geometric design problems.

MODULE 1, FOCUS 1: SENSING PROBLEMS AND CHALLENGES

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 1 -- Given instruction to enhance awareness of situations and conditions in need of improvement, the student will identify, by sketching and describing, problems in need of solution. The quality and type of problems generated will be to a level of completeness satisfactory to the instructor.

In order to do this, the student must be able to:

1. Define and identify wants, needs and values.
2. Sketch to describe and record information.
3. Project or role play "points of view" to understand how attitudes, values or perceptions affect sensing of problems and challenges.
4. Use deferred judgment.
5. Identify convergent and divergent thinking.

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Generate lists of problems from the students' own life experiences. Have students identify, by sketching or describing, things that need improvement. Use a positive focus as opposed to finding fault.

2. List problems, through sketching or describing, that could be generated from the following themes:

   Waste, bottlenecks, school, home, homework, anxieties, misunderstanding, transportation, communication, leisure, plans and goals, pet peeves, comfort, help for those with handicapping conditions, improvements, eating, complications, safety, inefficiencies, durability, appearance, friends, family, neighbors, shelter.

3. List problems, through sketching and describing, from the point of view of the following:

   A 3-year old; a 5-year old; a 1-year old; a 45-year old; a 75-year old; a 3- foot tall adult; an animal such as a dog or cat; a blind person; a deaf person; a mute person; a 150- lb. overweight person; a teacher; a doctor; a member of the clergy; a store owner; a fast food restaurant manager; a politician.

4. Using examples from strategies 1, 2 and 3, list, through sketching and describing, problems that might be seen through a combination of examples from each list: for example, pet peeves of a blind adult; transportation for a doctor.

Note: See Appendix C for additional Instructional Strategies

MODULE 1, FOCUS 2: INNOVATORS/INVENTIONS

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 1 -- Given access to the necessary data bases, the student will research and develop a report on an inventor and/or invention. The report will include both verbal and visual support materials. Activities will be completed to the satisfaction of the instructor.

In order to do this the student must be able to:

1. Utilize library research skills.

2. Research and analyze data collected.

3. Write a paper using documentation, note taking and writing skills.

SUGGESTED INSTRUCTIONAL STRATEGIES

GENERALIZATION: Encourage students to choose innovators and inventions unique and unfamiliar to them. The goal for the students is to expand their knowledge, rather than feed back that which they already know.

MODULE 1, FOCUS 3: INTRODUCTION TO APPLIED VISUAL TECHNIQUES

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 1 -- Given instruction and access to the necessary tools and materials, the student will describe objects and record problems through the use of graphic imagery. Students will produce realistic freehand sketches in pictorial drawing (isometric, oblique, and/or perspective) within pre-established criteria.

In order to do this the student must be able to:

1. Sketch the four basic shapes of cylinder, cube, cone and sphere.

2. Apply the five basic elements of shape in sketching contours: dot, circle, straight line, curve and angle family (Monart).

3. Apply the principles of pictorial drawing (isometric, oblique and/or perspective) in sketching.

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Participate in pictorial drawing exercises with a suitable level of developmental progression.

2. Maintain a DAILY LOG of realistic sketching. Some examples of drawing ideas include cylinder forms such as pots, cans, glasses, jugs, pill bottles, stacks of coins; cube forms such as boxes, sugar cubes, books, buildings, tables, chairs, toasters; cone forms such as ice cream cones, tents, funnels; pointed objects such as wood screws, nails; spherical forms such as apples, oranges, balls.

3. Maintain a design log of ideas generated in Sensing Problems and Challenges (Module 1, Focus 2, P.O. 1).

4. Conduct drawing activities from Drawing on the Right Side of the Brain, by Betty Edwards.

5. Conduct drawing activities from Drawing With Children, by Mona Brooks.

Note: See Appendix C for additional Instructional Strategies.

MODULE 1, FOCUS 3, Cont'd.

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 2 -- Given instruction and access to the necessary tools and materials, the student will develop solutions to two-dimensional geometric design problems. Students will produce accurate two-dimensional geometric models within pre-established criteria.

In order to do this the student must be able to:

1. Apply principles of geometric construction using a compass for dissecting a line, arc and angle, and constructing a triangle, square, pentagon, hexagon and octagon.
2. Apply the use of a protractor as in (1) above.

3. Use modeling materials such as tagboard, construction paper, foamcore and corrugated cardboard.

4. Use modeling tools and materials accurately and in a safe and proper manner.

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Complete measured paste-up of problem 1 in Appendix C.

2. Design and produce such items as the following:

   - a personal logo or flag
   - a flag for the combined countries of the United States, Mexico and Canada
   - a record album cover
   - a new yearbook cover or school logo
   - a poster to transmit a message without using words
   - a new paper or coin money for the United States or for international use

3. Design a leaf for a plant from another planet.

4. Construct tanagrams and participate in tanagram puzzle problems. Problems can be found in Tanagrams: 334 Puzzles by R. Read.

Note: See Appendix C for additional Instructional Strategies.

MODULE 1, FOCUS 3, Cont'd.

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 3 -- Given instruction and access to the necessary tools and materials, the student will develop solutions to three-dimensional design problems. The student will produce three-dimensional geometric models within pre-established criteria.

In order to do this the student must be able to:

1. Apply principles of geometric construction using a compass for bisecting a line, arc and angle, and constructing a triangle, square, pentagon, hexagon and octagon.

2. Apply the use of a protractor as in (1) above.

3. Use modeling materials such as tagboard, construction paper, foamcore, corrugated cardboard, plaster of paris, clay and wood.

4. Use modeling tools and materials accurately and in a safe and proper manner.

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Make a cylinder out of tagboard. The height should be three inches and the diameter 1-1/2 inches. The edge where the ends of the paper meet to form the cylinder side must be in the same plane on the outside surface, therefore a lap seam cannot be used. Tape is also prohibited in this exercise. The cylinder ends must be flush with the top and bottom of the sides. The sizes (height and diameter) can be changed to modify the problem. All dimensions must be accurate within 1/16th of an inch. Adhesive is the only fastener allowed.

2. Make a 2-1/2 inch cube out of construction paper. Any tabs are to be within the cube. No loose edges, pencil marks, or adhesive may show on the finished project. All dimensions must be accurate within 1/16th of an inch. Adhesive is the only fastener allowed.

3. Fabricate from foamcore a bottomless four-sided pyramid having an overall height of six inches and an exterior base measurement of six inches. The inside must be hollow with no internal supports or braces. The project will be judged by the tightness of the joints, both inside and out, the absence of excess glue, and the flatness of the bottom edges when resting against a flat plane. All dimensions must be accurate within 1/16th of an inch. Adhesive is the only fastener allowed.

4. Using corrugated cardboard and a form of press board or illustration board, fabricate a container in a closed right hexagonal cylinder form with a cover. The removable cover should be easy to remove from the bottom box, but fit tightly enough so that it will remain on when the box is held upside down. The two parts of the box may be covered with a material of the student's choice, e.g., paper, foil or fabric, so that no cardboard shows on the exterior of the box or at the edges where the two parts join. The entire interior must be visible and accessible. Do not use false tops or bottoms. The overall height of the container should be 7-1/2 inches. The cover's height should be 2-1/2 inches. The cord length of the hexagon exterior should be 2-1/2 inches.

5. Using an 11 x 17 inch sheet of pressboard, make the largest closed cube possible from the given material. All edges must be within 1/16th of an inch and all sides closed. Adhesive is the only fastener allowed. Calculate the interior volume.

6. Using a 9-1/2 x 11 inch sheet of pressboard, make the largest open rectangular box possible from the given material. Adhesive is the only fastener allowed. Calculate the interior volume.

7. Using the material provided, make the largest closed pyramid possible. All edges must be within 1/16th of an inch and all sides closed. Adhesive is the only fastener allowed.

Note: See Appendix C for additional Instructional Strategies.

MODULE 2: DATA FINDING
PROBLEM DEFINING
MODELING: STRUCTURE-MOVEMENT-CONTROL

DESCRIPTION OF MODULE:

Numerous studies have shown that instruction in creative techniques can produce significant improvement in creative behavior. This module will introduce new strategies related to creative problem solving in technology.

In problem solving, a variety of methods are available to attempt to reach a solution, including avoiding the problem altogether. When we look at a large parking lot, we can imagine many possible solutions to the land transportation problem, some far better than others. It is apparent that some methods of solving the same problem are capable of producing more optimal solutions.

After a problem, challenge or opportunity has been sensed, one must avoid identifying or formalizing a definition of the problem too soon, as this may inhibit the formation of many alternative solutions. For example, bed sores often plague restricted patients, which adds major cost to long-term hospital care. Bed sores are generally the result of conditions negatively affecting blood circulation, so immediate definition of the problem may indicate that the obvious solution is a better bed. A more creative approach, however, would consider such questions as, "How can bears and other mammals hibernate for long periods of little movement without getting sores?" and "Can studying the physiology of lizards or snakes, which maintain long periods of little movement, help provide solutions to this problem?" The idea is to avoid a single definition of the problem until extensive data from applied research has been acquired. It will then be possible to generate many possible problem definitions from different points of view.

Sketching, modeling and prototyping are primary skills needed to facilitate the data finding and problem defining stages in technical problem solving. To paraphrase an old adage, if a picture is worth a thousand words, then a model or prototype must be worth ten thousand. In addition, modeling from the different points of view such as structure, movement and control, with a particular element of technology, can enhance understanding of a particular problem. Indeed, applied visual techniques are essential to the solution of most technical problems in the real world.

This Module has a multiple focus:

FOCUS 1: DATA FINDING

Data Finding is a divergent-convergent process for gathering as much information as possible in preparation for defining the problem to be solved. Facts contribute to an understanding of what is going on and why. Therefore, having a broad database makes it increasingly possible to know why things are the way they are. The key words -- who, what, when, where, which, how, why and what if -- are used as fact-spurring devices. In data finding the objective is to list all information, both subjective and objective, including emotions, opinions and impressions. Important data is analyzed in the convergent stage. Data bases, such as libraries and other types of research resources, should be used.

Student Actions

- Apply data search skills; select and analyze data.
- Apply divergent and convergent thinking.
- Utilize deferred and affirmative judgment.
- Project or role play point of view to develop insight.
- Participate in group activities.

FOCUS 2: PROBLEM DEFINING

Problem defining is a divergent-convergent process for generating many possible statements of the problem and moving beyond the obvious to consider some new viewpoints or subproblems. Problem defining draws on information found in data finding and may result in the generation of new problems, challenges and the need for new data.

Student Actions

- Utilize data from Focus 1 (Data Finding) to develop problem statements.
- Project or role play point of view.
- Participate in group activities that require deferred and affirmative judgment.
- Formulate problem-defining statement from the phrase "In what ways might I/we ..."
- State, restate and redefine problem statements.

FOCUS 3: MODELING: STRUCTURE-MOVEMENT-CONTROL

Modeling: Structure-Movement-Control is designed to extend skills obtained in Module 1, Focus 3, and provide additional experience in modeling. Students will design, through sketching, plans or models in the three aspects of technology: Biologically Related Technology, Physical Technology, and Communication/Information Technology. One design sketch in each model area (structure, movement, control) is required, which results in nine sketches. A

minimum of three models are required. One model must be a combination of each aspect of technology and each model area. Supportive research is required for a presentation.

Student Actions

- Analyze and apply data from research.
- Sketch or draw to formulate, communicate, modify or transfer model designs.
- Use modeling tools, equipment, materials and systems for the production of models.
- Model elements from Biologically Related Technology, Physical Technology, Communication/Information Technology.
- Develop verbal presentation for each model.

SKILLS, KNOWLEDGE AND BEHAVIORS TO BE DEVELOPED:

1. Define and apply divergent and convergent thinking skills.

2. Utilize data search skills.

3. Select and analyze data.

4. Participate in role playing "points of view."

5. Participate in activities that require deferred and affirmative judgment.

6. Participate in group activities.

7. Restate problem defining statements.

8. Produce sketches for communication and formulation of ideas.

9. Use tools, equipment and materials for modeling safely and accurately.

10. Model elements of technology in Biologically Related Technology, Physical Technology and Communication/ Information Technology.

MODULE 2, FOCUS 1: DATA FINDING

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 1 -- Given instruction to enhance awareness of data finding techniques and sources, the student will apply the techniques to develop data for selected topics or ideas. Recordkeeping will be both visual and verbal with an emphasis on sketches, charts and graphs. Activities will be completed to the satisfaction of the instructor.

In order to do this the student must be able to:

1. Apply powers of observation in gathering data.
2. Sketch or draw to record information.
3. Project or role play points of view to develop insight.
4. Use deferred judgment.
5. Participate in group activities.
6. Apply the words who, what, when, where, which, why, how and what if, to develop fact finding questions.
7. Utilize research data bases, e.g., libraries and computer searches.

SUGGESTED INSTRUCTIONAL STRATEGIES

GENERALIZATION: In the following instructional strategies, the idea-spurring questions, who, what, where, when, how, why and what if, should be applied when appropriate. In addition, important data generated should be analyzed further. Students will research data bases, such as libraries and computer searches. Students should project or role play to develop insight.

1. Apply data finding techniques to selected problems generated in Module 1, Focus 1 (Sensing Problems and Challenges).
2. Use data finding techniques to list and analyze facts and information which may help identify what could be modeled for elements within Biologically Related Technology.
3. Use data finding techniques to list and analyze facts and information which may identify what could be modeled for elements within Physical Technology.
4. Use data finding techniques to list and analyze facts and information which may identify what could be modeled for elements within Communication/Information Technology.
5. Using data finding techniques, investigate the following: a donut, an aspirin, a cassette tape, a piece of braille, a

door knob, a drop of water, a ray of the sun.

Note: See Appendix C for additional Instructional Strategies.

MODULE 2, FOCUS 2: PROBLEM DEFINING

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 1 -- Given instruction to enhance awareness of problem finding techniques, the student will apply the techniques. The student will develop problem statements for stated topics or ideas. Activities will be completed to the satisfaction of the instructor.

In order to do this the student must be able to:

1. Participate in activities that require deferred and affirmative judgment.
2. Participate in group activities.
3. Project or role play points of view to develop insight.
4. Formulate problem defining statements from the phrase, "In what ways might I/we ..."
5. State, restate and redefine problem statements.

SUGGESTED INSTRUCTIONAL STRATEGIES

GENERALIZATION: In the following Instructional Strategies the idea-spurring questions, "What if?" and "In what ways might I/we?" should be applied to restate and redefine problems. In addition, students should participate in activities that require deferred and affirmative judgment. Students should project or role play to find insight. Students will formulate problem defining statements.

1. Apply problem defining techniques to selected problems generated in Module 1, Focus 1 (Sensing Problems and Challenges) based on data finding.
2. Apply problem defining techniques to data found on possible models that could be developed for elements within Biologically Related Technology in the previous focus.
3. Apply problem defining techniques to data found on possible models that could be developed for elements within Physical Technology.
4. Apply problem defining techniques to data found on models that could be developed for elements within Communication, Information Technology.

MODULE 2, FOCUS 3: MODELING: STRUCTURE-MOVEMENT-CONTROL

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 1 -- Given instruction and access to the necessary tools and materials, the student will produce nine model sketch designs. Designs will be produced from each aspect of technology: Biologically Related Technology, Physical Technology, and Communication/Information Technology. One model design sketch will be produced in structure, movement and control for each aspect of technology. Model designed sketches will be completed to the satisfaction of the instructor.

In order to do this the student must be able to:

1. Participate in role playing "points of view."
2. Utilize data research skills.
3. Sketch or draw to record, formulate and communicate ideas. (Optional -- Computer Assistance)
4. Record research information.

SUGGESTED INSTRUCTIONAL STRATEGIES

GENERALIZATION: The result of Module 2, Focus 3, P.O. 1 will be nine model design sketches produced and submitted by the students for the instructor's consideration. Nine model themes appear below. The samples of results listed are for information only.

MODEL THEMES	POSSIBLE MODEL DESIGN SKETCHES	
Biologically Related Technology	Structure:	bones, exo-skeletons, seeds
	Movement:	blood flow, joints, muscles, animal flight
	Control:	nerve cell, sensors, food chain, brain
Physical Technology	Structure:	bridges, buildings, frames
	Movement:	vehicles, gears, flight
	Control:	mechanical timers, thermostats
Information/Communication Technology	Structure:	braille, languages
	Movement:	fiber optical, radio, television
	Control:	sensors, robotics

Though model design sketches may fit into more than one theme category, the designs should reflect the major thrust of the theme. For example, the following depicts biologically related model design sketches of blood in each category:

1. Structure-- physical make-up, chemicals, H_2O
2. Movement-- circulation, capillary action
3. Control-- white blood cells for infection, red blood cells for oxygen, clotting factors

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 2 -- Given instruction and access to the necessary tools, equipment and materials, the student will produce three models from model designs found in Module 2, Focus 3, P.O. 1. One model must result from a combination of each aspect of technology and each model area. A verbal presentation will be to a level of completeness satisfactory to the instructor.

In order to do this the student must be able to:

1. Analyze and apply data from research.
2. Sketch or draw to formulate, communicate, modify or transfer model designs.
3. Use modeling tools, equipment and materials accurately and in a safe and proper manner.
4. Use modeling systems (e.g., Lego Technic, Fischer Technik, Meccano, Erector, Computer Model)

SUGGESTED INSTRUCTIONAL STRATEGIES

GENERALIZATION: The result of Module 2, Focus 3, P.O. 2 will be three model designs produced and submitted by the students for the instructor's consideration. In addition, a verbal report will be presented which may be prerecorded or contain prerecorded elements.

LIST OF POSSIBLE MODEL IDEAS:

Biologically Related Technology -- Leaf structure, skin, fingerprints (enlarged), hair follicle, bones, joints, teeth, muscle, organs, scales, roots, food cycles, food processing, insects, genes, DNA, animal flight.

Physical Technology -- Transportation system elements: roads, land, aerospace, water vehicles. Subsystem components: mechanisms, energy systems or subsystem. Materials: plastics, bridges, composites, shelter.

Communication/Information Technology -- Graphic communication systems and subsystems, photography, fiberoptics, braille, audio/visual system and subsystem, historic communication system.

MODULE 3: IDEA FINDING
SOLUTION FINDING
CREATIVE ACTIVITY BRIEFS (CABS)

DESCRIPTION OF MODULE:

In this module, the student develops solutions to loosely defined problems called Creative Activity Briefs. Problem solving skills in relation to Idea Finding and Solution Finding will be developed. Assumed in this module is the reapplication of Sensing Problems and Challenges, Data Finding, and Problem Defining from previous modules. This module addresses skills, knowledge, behaviors and techniques found helpful in the production of unique, novel and useful ideas. Ideas are then evaluated by criteria generated and selected for application.

Seldom in high school does the opportunity exist to experience activities related to current and emerging technology. Creative Activity Briefs (CABS) focus on elements of technology within the three aspects of technology: Biologically Related, Physical, and Communications/Information Technology. Students experience activities related to each aspect of technology, and further enhance their ability to form relationships between these aspects. This creative, cross-discipline approach promotes generalization, integration and application of skills learned in content-specific disciplines. In addition, these activities do the following:

1. Enhance data search skills (e.g., library, computer, interview).
2. Provide experiences with the higher-level thinking skills such as application, analysis, synthesis and evaluation.
3. Provide cross-academic and cross-gender experiences.
4. Stress visual thinking.
5. Stress creative thinking skills and techniques such as brainstorming, fluency, flexibility, elaboration and original thinking.
6. Provide experience in development of criteria to evaluate ideas generated.
7. Provide a background for synectics.
8. Provide a career guidance function that aids in clarification of goals, interests and abilities.

This module has a multiple focus:

FOCUS 1: IDEA FINDING

Idea finding is primarily a divergent process that stresses the generation of as many ideas as possible for solving the problem. All ideas are accepted. The four more common thinking skills -- fluent, flexible, elaborative and original thinking -- are emphasized. Brainstorming guidelines that include deferred judgment, striving for quantity, freewheeling and hitchhiking should be followed. Idea-spurring questions and forced relationships help the search for new ideas.

Student Actions

- Distinguish the difference between *personal value judgment and **evaluative judgment.
- Apply brainstorming techniques and guidelines.
- Apply evaluative judgment.
- Project or role play points of view to develop insight for the development of criteria.

* personal value judgment -- based on personal choice, likes, attitudes, preference, belief.

** evaluative judgment -- based on evidence, criteria, established standards.

FOCUS 3: CREATIVE ACTIVITY BRIEFS

Creative Activity Briefs (CABS) are loosely defined problems that generally have no one complete, preconceived answer, but are not completely open due to artificial limits placed on the resources. The term, resources, is meant to include time, information, materials, tools/machines, capital, energy and people. The artificial limitations on the resources limits the scope and technical difficulty of the problem.

Categories for CABS are Biologically Related Technology, Physical Technology, and Information/Communication Technology. Technology, however, in the real world is not always distinct and separate. Therefore, some crossover among the aspects of technology, the Creative Activity Brief and the solution is to be expected and desired. In addition, student-generated CABS may be used for innovation and invention. Depending on the CABS selected through student/teacher consultation, the CABS will generally be solved through a learning team/group approach.

Student Actions

- Utilize the techniques of Sensing Problems and Challenges, Data Finding, Problem Finding, Idea Finding and Solution Finding.
- Sketch or draw to record, formulate, communicate, modify and evaluate ideas.
- Use tools, equipment, materials and processes accurately and in a safe and proper manner.

SKILLS, KNOWLEDGE AND BEHAVIORS TO BE DEVELOPED:

The ability to:

1. Apply divergent and convergent thinking skills.

2. Participate as an individual and in a group in activities that require deferred and affirmative judgment.

3. Utilize idea-finding or idea-spurring questions and skills.

4. Produce sketches for communication, formulation and recording of ideas.

5. Apply evaluation techniques for judgment of ideas.

6. Use tools, equipment and materials for problem solutions safely and accurately.

7. Model or prototype solutions to loosely defined problems.

MODULE 3, FOCUS 1: IDEA FINDING

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 1 -- Given instruction to enhance awareness of idea-finding techniques, the student will apply and participate in idea-finding activities. The student will list, through drawing and description, all ideas generated. Activities will be completed to the satisfaction of the instructor.

In order to do this the student must be able to:

1. Apply the thinking skills of fluency, flexibility, elaboration and originality.

2. Apply brainstorming techniques and guidelines.

3. Apply idea-spurring terms such as adapt, eliminate, modify, magnify, minify, substitute, rearrange, reverse, combine and put to other uses.

4. Apply idea-spurring words such as who, what, when, where, which, how, why and what if.

5. Utilize deferred and affirmative judgment.

SUGGESTED INSTRUCTIONAL STRATEGIES

GENERALIZATION: In the following instructional strategies, the reapplication of techniques used in Sensing Problems and Challenges, Fact Finding, and Problem Finding are expected. New problems can be developed by applying Module 1, Focus 1 (Sensing Problems and Challenges) and continuing through the process found in subsequent modules.

1. The small ketchup package containers used in fast food restaurants are difficult to open. Using the idea-finding techniques, list possible solutions.

2. At times, child-proof prescription drug lids are difficult to open. Using the idea-finding techniques, list possible solutions.

3. Toothpaste tubes rarely close properly and excess toothpaste is often found on the outside of the tube. Using the idea-finding techniques, list possible solutions.

4. Household waste results in disposal problems. Using idea-finding techniques, list possible solutions.

5. Candy is a popular product with the American consumer, so new candy products are of interest. Using idea-finding techniques, list possible ideas.

6. New fads are popular with the American consumer. Using idea-finding techniques, list possible ideas.

Lists of problems can be found in the instructional strategies of Module 3, Focus 3, P.O. 1 -- Creative Activity Briefs (CABS).

MODULE 3, FOCUS 2: SOLUTION FINDING

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 1 -- Given instruction to develop awareness of solution-finding techniques, the student will apply and participate in solution-finding activities. Students will develop criteria to evaluate and will evaluate ideas found in Module 3, Focus 1, P.O. 1 (Idea-Finding). Activities will be completed to the satisfaction of the instructor.

In order to do this the student must be able to:

1. Distinguish between *personal value judgment and **evaluative judgment.
2. Apply brainstorming techniques and guidelines.
3. Apply evaluative judgment.
4. Project or role play points of view to develop insight for the development of criteria.

* personal value judgment -- based on personal choice, likes, attitudes, preference, belief.

** evaluative judgment -- based on evidence, criteria, established standards.

SUGGESTED INSTRUCTIONAL STRATEGIES

GENERALIZATION: Solution finding focuses on developing criteria to evaluate ideas produced through idea finding. The divergent phase involves generating many criteria. The convergent phase involves choosing and using the selected criteria to evaluate, screen and support the most promising ideas from Module 3, Focus 1, P.O. 1. Emphasis should be placed on projecting or role playing points of view. Idea-spurring words, such as who, what, when, where, which, how, why and what if, should be applied. Where appropriate, additional questions may be asked concerning cost, the effect on groups or individuals, what tangible resources are involved (tools, materials, equipment), and what intangibles are involved (aesthetics, attitudes, feelings, knowledge, opinions, values).

Apply the above generalization to Module 3, Focus 1, P.O. 1.

MODULE 3, FOCUS 3: CREATIVE ACTIVITY BRIEFS

PERFORMANCE OBEJCTIVE/SUPPORTING COMPETENCIES

P.O. 1 -- Given instruction and access to the necessary tools, equipment and materials, the student will produce models, prototypes and/or other appropriate design solutions to Creative Activity Briefs (CABS). CABS will be selected through mutual consultation between the instructor and the student. Students will participate in CABS individually or in learning teams. Solutions will be to a level of completeness satisfactory to the instructor.

In order to do this the student must be able to:

1. Utilize the techniques of Sensing Problems and Challenges, Data Finding, Problem Finding, Idea Finding and Solution Finding.

2. Sketch or draw to record, formulate, communicate, modify and evaluate ideas.

3. Use tools, equipment, materials and processes accurately and in a safe and proper manner.

SUGGESTED INSTRUCTIONAL STRATEGIES

GENERALIZATION: A set of Creative Activity Briefs (CABS) may be found in Appendix D. CABS are loosely defined problems that generally have no one complete, preconceived answer, but are not completely open due to artificial limits placed on the resources. The term, resources, is meant to include time, information, materials, tools/machines, capital, energy and people. The artificial limitations on the resources limit the scope and technical difficulty of the problem.

A Creative Activity Brief Guidebook, intended as an aid in the completion of the activity, may be found in Appendix D.

MODULE 4: ACCEPTANCE FINDING
COMPLEX/UNCLARIFIED PROBLEMS
PROBLEM SOLVING SYSTEMS

DESCRIPTION OF MODULE:

In this module students will develop solutions to complex and unclarified problems. Problem solving skills in relation to acceptance finding will be developed. Acceptance Finding is the skills, knowledge, behaviors and techniques necessary to develop a plan of action for implementation of promising ideas. Additional problem solving systems will be introduced. Assumed in this module is the reapplication of Sensing Problems and Challenges, Data Finding, Problem Defining, Idea Finding and Solution Finding from the previous modules.

Robert Browning said, "A man's reach should exceed his grasp." Learning to exceed one's grasp is part of the creative skill that is the pride of America. A critical goal of education is to nurture creative problem solving behavior in technology that personifies the concepts of "American Ingenuity," "Yankee Know-How," and the "Can-Do Attitude."

This module provides experience with a complete problem solving system designed to produce optimal solutions. Solutions, however, are of little value unless implemented. To that end, drawing, modeling and prototyping of the solution, as well as developing a plan of action, are considered essential to the implementation of ideas in technology.

This module has a multiple focus:

FOCUS 1: ACCEPTANCE FINDING

Acceptance Finding stresses the development of an organized plan of action for problem solving. It is a divergent and convergent process that generates many factors that may assist in or resist implementation, and the solution of key factors for the development of a plan. Included in this acceptance of a solution to a technical problem may be graphic design, modeling, prototyping, testing, evaluation and elaboration.

Student Actions

- Apply techniques introduced in Sensing Problems and Challenges, Data Finding, Problem Defining, Idea Finding and Solution Finding.
- Analyze factors that may assist in, or resist, implementation of the idea.
- List resources needed and their sources.
- Predict possible problems with implementation.
- Sketch or draw to record, formulate, communicate, modify and evaluate ideas.
- Develop a plan of action to implement solutions to problems.

FOCUS 2: COMPLEX/UNCLARIFIED PROBLEMS

Complex/Unclarified Problems meet all of the following criteria: (1) the problem has a degree of technical complexity, (2) the given problem statement must be analyzed, synthesized, redefined and developed before problem solving can begin, (3) the problem is generated from a source such as personal, school, community or society related concerns. A clear relationship must be shown between the problem and the real problems in the world.

Student Actions

- Utilize the techniques of Sensing Problems and Challenges, Data Finding, Problem Finding, Idea Finding, Solution Finding and Acceptance Finding.
- Sketch or draw to record, formulate, communicate, evaluate or elaborate upon ideas.
- Use tools, equipment, materials and processes accurately and in a safe and proper manner.
- Design, model or prototype solutions to complex/unclarified problems.

FOCUS 3: PROBLEM SOLVING SYSTEMS

An introduction to a variety of problem solving systems is provided as a stimulus to extend the student's perception of problem solving approaches and methods.

Student Actions

- Record and categorize information.
- Define terms related to specific problem solving systems.

SKILLS, KNOWLEDGE AND BEHAVIORS TO BE DEVELOPED:

The ability to:

1. Apply techniques introduced in Sensing Problems and Challenges, Data Finding, Problem Finding, Idea Finding and Solution Finding.

2. Produce sketches to communicate, formulate, record and develop solutions to problems.

3. Use tools, equipment and materials for problem solutions safely and accurately.

4. Design, model and/or prototype solutions to complex/unclarified problems.

5. Develop a plan of action to implement solutions to problems.

6. Identify elements within problem solving systems.

MODULE 4, FOCUS 1: ACCEPTANCE FINDING

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 1 -- Given instruction to enhance awareness of acceptance finding techniques, the student will apply and formulate a plan of action to implement a promising idea. Ideas used should be found through the application of the techniques introduced in the previous modules. Activities will be completed to the satisfaction of the instructor. (See Appendix D.)

In order to do this the student must be able to:

1. Apply techniques from previous modules.
2. Analyze factors that may assist in or resist implementation of the idea.
3. List resources needed and their sources.
4. Predict possible problems with implementation.
5. Sketch or draw to record, formulate, communicate, modify and evaluate ideas.
6. Use tools, equipment, materials and processes accurately and in a safe manner.

SUGGESTED INSTRUCTIONAL STRATEGIES

GENERALIZATION: In the instructional strategies used in this module, the reapplication of the techniques used in Sensing Problems and Challenges, Fact Finding, Problem Finding, and Solution Finding is required. New problems can be developed to form a category called "Real Problems." Real Problems may be generated from the following areas: personal life, school, community, society, service groups and areas that elicit a high degree of student ownership. In addition, problems used in Module 4, Focus 2, P.O. 1 require the application of acceptance finding and may be used to complete the performance objectives.

MODULE 4, FOCUS 2: COMPLEX/UNCLARIFIED PROBLEMS

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 1 -- Given necessary instruction, and access to the necessary tools, equipment, materials and processes, the students will produce solutions to complex/unclarified problems. The problems will be selected through mutual consultation between the instructor and the students. The students will participate individually or in learning teams. Solutions will be at a level of completeness satisfactory to the instructor. (See Appendix E.)

In order to do this the student must be able to:

1. Utilize the techniques of Sensing Problems and Challenges, Data Finding, Problem Finding, Idea Finding, Solution Finding and Acceptance Finding.

2. Sketch or draw to record, formulate, communicate, modify, evaluate or elaborate upon ideas.

3. Use tools, equipment, materials and processes accurately and in a safe and proper manner.

SUGGESTED INSTRUCTIONAL STRATEGIES

GENERALIZATION: Complex/Unclarified problems must meet the following criteria:

(1) The problem has a degree of technical complexity.

(2) The given problem statement must be analyzed, synthesized, redefined and developed before problem solving can begin.

(3) The problem is generated from a source such as personal, school, community or society related concerns, and a clear relationship can be shown between the problem and real problems in the world.

A partial list of problems is included in Appendix E. New problems can be generated by the reapplication of the techniques found in this and previous modules.

MODULE 4, FOCUS 3: PROBLEM SOLVING SYSTEMS

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

P.O. 1 -- Given instruction to develop awareness of various problem solving systems, the students will identify problem solving steps within a particular system. The activity will be completed to the satisfaction of the instructor.

In order to do this the student must be able to:

1. Record and categorize information.
2. Define terms related to specific problem solving systems.

SUGGESTED INSTRUCTIONAL STRATEGIES

GENERALIZATION: This performance objective is designed to introduce various problem solving systems. The students are expected to become aware that other methods exist for problem solving than the creative problem solving model used thus far in this course. It is suggested that other systems or combination of systems be used as an extension of this course or for enrichment.

See Appendix B for a list of various problem solving techniques.

APPENDIX A

Terminology

TERMINOLOGY

AFFIRMATIVE JUDGMENT -- Constructive consideration and analysis of ideas with a somewhat positive emphasis.

CONVERGENT THINKING -- Critical consideration of the possibilities including choosing from many alternatives, reaching conclusions, synthesizing.

CREATIVE PROBLEM SOLVING -- (CPS) A process for using specific techniques of creative and critical thinking for the purpose of solving a problem and implementing a solution.

DEFERRED JUDGMENT -- Delayed use of evaluation (criticism or praise) during the process of the generation of ideas.

DIVERGENT THINKING -- Generating many possible alternative ideas. Emphasis may be placed on the skills of fluency, flexibility, originality and elaboration.

ELABORATION -- The ability to add details to a basic idea produced.

FLEXIBILITY -- The ability to change an idea and see new ideas come forth.

FLUENCY -- The ability to produce many ideas for a given task.

ORIGINALITY -- The ability to produce ideas that are unusual, remote and clever.

APPENDIX B

PROBLEM SOLVING TECHNIQUES

THINKING

HIGHER TRAITS	LOWER TRAITS
Welcomes problematic situations	Searches for certainty
Looks for alternate solutions	Intolerant of ambiguity
Reflective and deliberate	Satisfied with the first attempt
Revises goals when necessary	Seldom revises goals
Open to multiple possibilities	Prefers to limit possibilities
Considers and seeks alternatives	Seldom seeks alternatives
Utilizes evidence that challenges favored possibilities	Ignores evidence that challenges favored possibilities

THE PROCESS

CREATIVE PROBLEM SOLVING	TECHNICAL PROBLEM SOLVING
Sensing Problems and Challenges	Applied Visual Techniques
Data Finding	Inventions/Inventors
Problem Finding	Modeling/Prototyping: Structure-Movement-Control
Idea Finding	Technology -- Physical Communication/Information, Biological
Solution Finding	Creative Activity Briefs (CABS)
Acceptance Finding	Complex/Unclarified Problems

ENVISIONEERING$_{TM}$

The combination of Creative Problem Solving and Technical Problem Solving for the purpose of the development of skills, knowledge, behavior and concepts that lead to creative problem solving behavior in technology is called Envisioneering$_{TM}$.

APPENDIX C

AIDS FOR MODULES 1 AND 2

AIDS FOR MODULES 1 AND 2

Module 1, Focus 1, P.O. 1

References:

Creative Problem Solving: The Basic Course, by Scott Isaksen and Donald J. Treffinger
The Universal Traveler, by Don Koberg and Jim Bagnell

Module 1, Focus 2, P.O. 1

References:

The Art of Successful Inventing, Inventions, Inventors and You, by Edward Shlesinger, Jr.

Module 1, Focus 3, P.O. 1

References:

Draw!, by Kurt Hanks and Larry Belliston
Design Yourself, by Kurt Hanks, Larry Belliston, Dave Edwards
Rapid Viz, by Kurt Hanks and Larry Belliston
Drawing on the Right Side of the Brain, by Betty Edwards
Drawing with Children, by Mona Brooks

Module 1, Focus 3, P.O. 2

References:

Drafting with Graphics, by J.W. Giachino and H.J. Beukema
Technical Drawing, by Giesecke, Mitchell, Spencer, Hill
Exploring Drafting, by John Walker
Creative Constructions, by Seymore and Schadler

Module 1, Focus 3, P.O. 3

References:

Model Buildings and How to Make Them, by Harvey Weiss
Model Airplanes and How to Build Them, by Harvey Weiss
Building: The Fight Against Gravity, by Mario Salvadori

Module 2, Focus 1, Data Finding

Sources: Catalog -- Transtech Systems
Division of Creative Learning Systems
9889 E Hilbert Street
San Diego, CA 92131

Module 2, Focus 2, Problem Defining

References:

Wake Up Your Creative Genius, by Kurt Hanks and Jay A. Perry

Module 2, Focus 3, Modeling: Structure-Unit-Control

Sources: Catalog -- Plastruct
1020 South Wallace Place
City of Fun, CA 91748

Catalog -- Evergreen Scale Models Inc.
12803 N.E. 125th Way
Kirkland, WA 93034

MEASURED PASTE-UP EXERCISE STUDENT INFORMATION

As man developed more complex needs and wants, it became necessary to develop methods of combining technology. Thus, when using only a stone as a tool gave way to using types of hammers with handles, methods of fastening were developed. In this activity students will apply fastening systems for solids, e.g., Adhesion, Cohesion, Mechanical Fastening or combinations thereof. Comparisons will be made between historical, present and futuristic methods of fastening.

The following exercise requires a sheet of typing paper for the background and two different colors of construction paper. Its purpose is to develop skill in measuring, cutting and thinking. All parts marked "A" should be one color and those marked "B" another color. Practice cutting and gluing with scrap material before gluing up the final presentation. Observe the amount of glue needed to prevent wrinkling and use books or some other weight to press the paper together while the glue is drying. Be sure to put your name on the back of the paper before handing it in.

EQUIPMENT AND SUPPLIES:

Ruler, Protractor, Compass, Glue, Utility Knife,
Typing Paper, Colored Construction Paper

The following provides information for teachers to use themselves or relay to students to facilitate this activity:

1. Take five to ten minutes with a pencil and scratch pad, thinking of and sketching different possible strategies. Many great ideas have developed from this type of thinking.

2. Review constructing a perpendicular, bisecting an angle, drawing a circle, drawing a hexagon, and drawing an equilateral triangle.

3. Determine the order or sequence of operations by asking such questions as the following:

   Which color paper is the field?
   Which form is glued first?
   Are the larger, less detailed pieces glued first?

4. A good strategy is to cut all the pieces first, position them, check accuracy of placement, and then glue all the pieces at once.

CONSTRUCTION TIPS

- Use dividers to locate position of forms.
- Use light table or backlit window and graph paper to locate forms.
- Use the following strategies:
  - Jig-sawing -- pasting pieces together (probably the most obvious way)
  - Piercing -- overlay -- cutting windows
  - Weaving -- cutting slits, like the paper placements many students constructed in the primary grades.
  - Layering -- stack four sheets, one on top of another, the uppermost being a quickly but accurately constructed pencil layout, and pinprick through the four layers. The pin holes are connected with a straight edge and cut. This ensures correct positioning.
- Save time by gluing those pieces that contact the edge and trimming them after the glue has dried.

Consider the following when reviewing students' work:

DID THE STUDENTS

- Check the information given and make the wrong assumptions? For example:
  - Is the paper called for in the exercise your standard size paper?
  - Is the drawing accurate or contradictory? For instance, do the composite dimensions add up to

the total dimension?
- Do the dimensions make sense when checked against what is seen in the drawing?

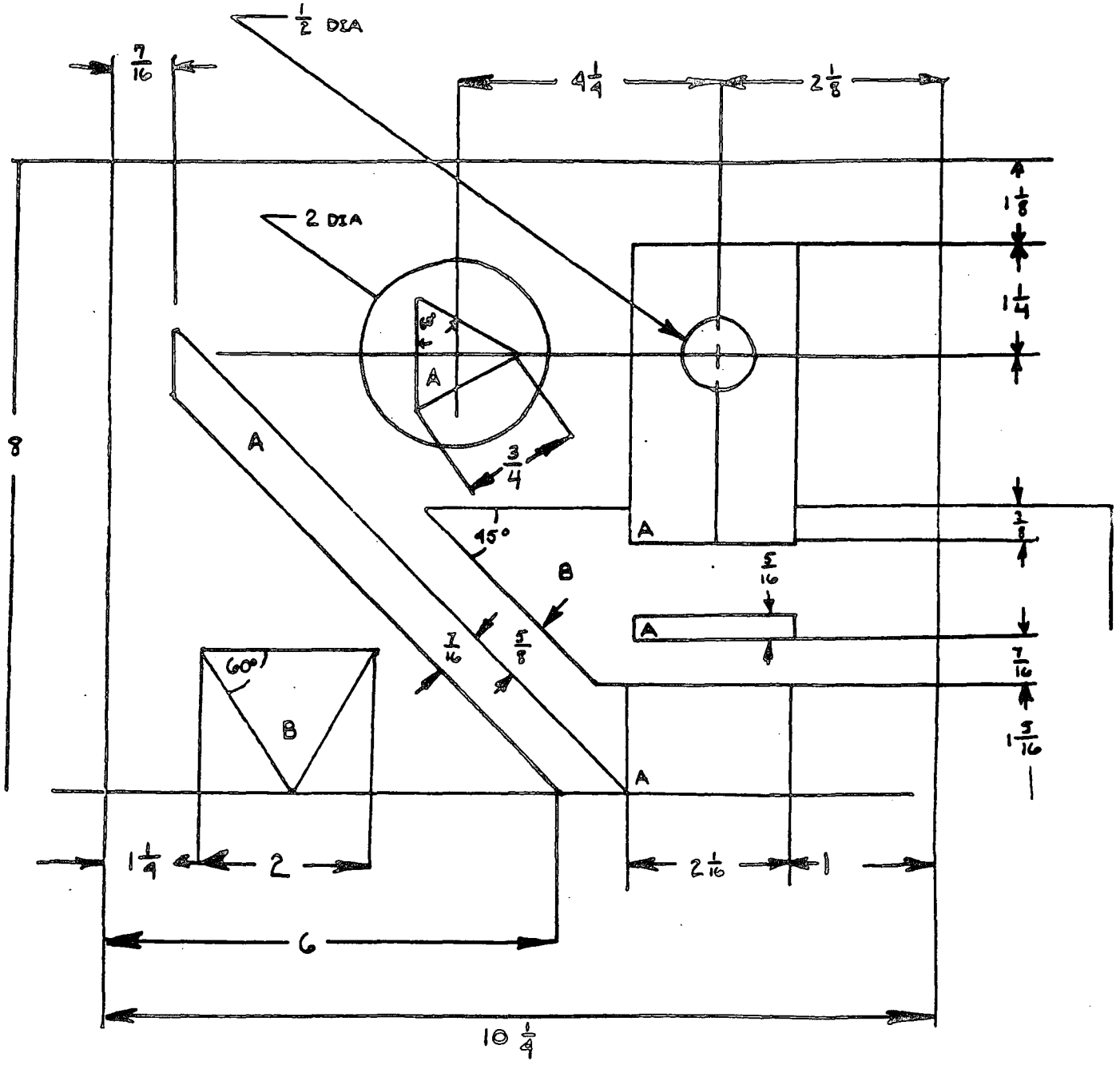
- Know different ways to locate lines and intersections? For example: pencil tick mark, pin prick (push pins make good marking tools), knife.

- Think about parallax and its relation to marking with a ruler?

- Think about cutting methods? For example:
  - Scissors and deforming of the paper
  - Mat or Exacto Knife

- Think about the reason for placing straight edge over good material? (Use cutting a mat for a print or photo as an example.)

MEASURED PASTE-UP



APPENDIX D

CREATIVE ACTIVITY BRIEFS (CABS)

CREATIVE ACTIVITY BRIEFS

Creative Activity Briefs (CABS) are loosely defined problems that have no one complete, preconceived answer. They are not completely open due to artificial limits set on the resources. The term "resources" is meant to include time, information, materials, tools/machines, capital, energy and people. The artificial limitations on resources limit the scope and technical difficulty of the problem.

To create CABS, the following statement must be completed from the source from which the challenge is derived:

1. General statement of the challenge, activity or problem

2. Resource limitations

3. Rules and regulations

In addition, the level of technical difficulty should not be unreasonably high. The actual solution could be a subproblem to a larger, more complex problem that may be found in Module 4.

The following is an example of a Biologically Related Technology CAB:

CHALLENGE: Grow a plant which produces the largest mass.

RESOURCE LIMITATIONS: Sunflower seeds, three weeks, a portable growing system.

RULES AND REGULATIONS:

1. Grow at least four plants (two control plants and two experimental plants).
2. Grow as many sunflower plants as you wish.
3. Keep records of how you treat your plants. For example, keep track of the following variables:
   a. date planted
   b. amount of potting soil
   c. fertilizer type and amount
   d. light type and amount
   e. amount and frequency of watering
4. Give your control plants water, normal sunlight and nothing else.
5. Treat your experimental plants in any way that you think will help them to grow.

Reference: Discovering Science, Sunburst Communications, Pleasantville, NY 10570-9971

The following is an example of a Physical Technology CAB:

CHALLENGE: Design and build a four-wheel vehicle.

RESOURCE LIMITATIONS: Only the following materials may be used in the construction of the vehicle:

paper	wood	lubricant	tin/aluminum cans
string	coat hangers	tape	thread spools
staples	paper clips	wire	aluminum foil
pencils	glue	pins	computer cards
			ball point pens

four wheels and axles (commercially bought)
rubber band (not as an additional power source)

Only the following materials may be used as power sources:

One 1/4 x 12 inch rubber band (available at hobby shops)
One wood and spring type mouse trap
One small, round balloon

RULES AND REGULATIONS: The maximum dimensions of the vehicle will be 60 cm high x 30 cm wide x 60 cm long and must contain a holder for 100 pennies. The payload should be removable for verification by the judges after testing. The vehicle must be powered only by the approved power sources individually or in any combination. The vehicle must stay in contact with the floor at all times and must stay in one piece to be reusable for several trials.

Reference: JETS, Inc.
United Engineering Center
345 East 47th Street
New York, NY 10017

The following is an example of an Information/Communication Technology CAB:

CHALLENGE: Messages sent are not always received. Design a message, such as a commercial or public service message, for use on the radio that is unique in its effect.

RESOURCE LIMITATION: The message must be recorded on an audio cassette tape. The total cost must not exceed $3.00.

RULES AND REGULATIONS:

1. Positive intent.
2. Time limit is 30 seconds.
3. Must include music.
4. Written script must be presented.

CREATIVE ACTIVITY BRIEFS GUIDEBOOK

TEAM NAME _____ INSTRUCTOR _____

TEAM MEMBER'S NAME _____ DATE STARTED _____

_____ DATE COMPLETED _____

_____

_____

1. INTRODUCTION -- CONGRATULATIONS! You are about to choose an activity that you want to work on. It is impossible to find one source that will give you all the material you need for one particular subject area. However, you can learn a great deal by looking through books, magazines and encyclopedias, experimenting with materials, talking with resource people and doing computer searches. After you have completed your research, you will most likely know more about your topic than any of your classmates. At that point, you have earned the title of specialist and will be able to share your own information with the class.

   This guidebook is to help you as you work on your project. If you read it carefully and follow the suggestion, you will find your work much easier.

2. You cannot do this project all on your own. You will need the help of others such as a teacher, friend, parent or librarian. When you find someone who takes an interest and would like to help you, allow them to do so. Look for any kind of information which can be valuable to you. Don't be afraid to ask for help.

3. ASPECT of TECHNOLOGY _____ Bio. Tech _____ Phys. Tech

   ____ Comm./Info. Tech

4. SENSING PROBLEMS AND CHALLENGES -- DESCRIPTION OF PROJECT
   (What's the problem?)

   Use this space for drawings

   _____
   _____
   _____
   _____
   _____
   _____
   _____
   (If needed use another page)

5. DATA FINDING -- WHO, WHAT, WHEN, WHERE, WHICH, WHY, HOW and WHAT IF?

(Get the facts!)

Use this space for drawings

(If needed use another page)

6. DATA SOURCES -- CHECK LIST

___ encyclopedia
___ dictionaries
___ textbooks
___ biographies
___ magazines
___ almanac
___ library card catalog
___ index of free materials
___ library
___ historical societies
___ business places
___ exploring in nature
___ resource people
___ teachers
___ factories
___ musicians/artists
___ computer search
___ pictures
___ charts
___ graphs
___ instructional films
___ television
___ newspapers
___ maps
___ bibliographies
___ museums
___ antique shops
___ research laboratories
___ art galleries
___ town officials
___ librarians
___ manufacturing companies
___ Chamber of Commerce
___ colleges

Others: _____

7. PROBLEM FINDING -- Restate and redefine the problem.
(In what ways might we ... What if ...)

Use this space for drawings

(If needed use another page)

8. IDEA FINDING -- IDEATION

Use this space for drawings

(If needed use another page)

9. SOLUTION FINDING -- Develop criteria to evaluate ideas and resolve the problem.

Use this space for drawings

(If needed use another page)

10. ACCEPTANCE FINDING -- Plan of Action -- Who, What, When, Where, Which, Why, How, What If, as they apply to assistance in, or resistance to, the implementation of the idea. Implementation -- Design, Model, Prototype, Test, Evaluate, Elaborate.

Use this space for drawings

(If needed use another page)

Ideas for sharing your project:

posters	murals	graphs
video tape	dioramas	displays
oral or written reports	charts	slides